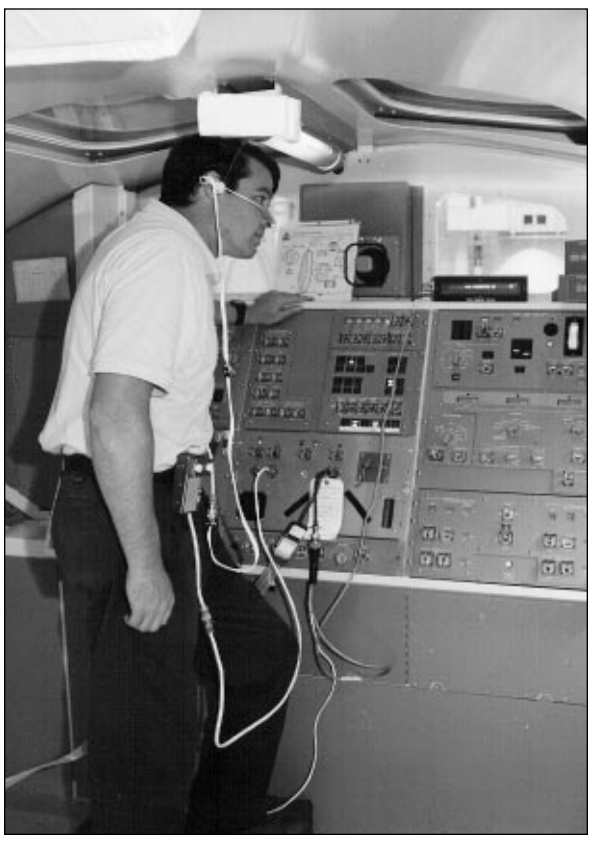


From top to bottom:

1) STS-78 Commander Tom Henricks practices with the Voice Command System in the Bldg. 9 Manipulator Development Facility.

2) The VCS development team includes, from left, Darilyn Gaston, Eric Kuehnel, Fred Clifton, George Salazar, Hector DeLeon, Dena Haynes and Marc Sommers. Salazar said working with the team was a rewarding experience."I feel fortunate to have such a great group of people working with me on this project," he said. "Ideas and different approaches to doing something were always welcomed. Without question, it's the people that make a project a success or not."

3) STS-78 Pilot Kevin Kregel works with the VCS in preparation for this month's flight.

4) STS-41 Mission Specialist Bruce Melnick works with the original VCS test equipment on orbit.

JSC Photos

Word Smiths

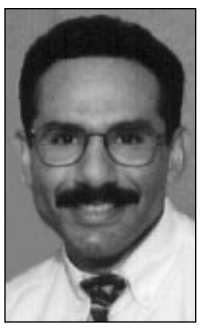
JSC team gets closer to making it possible for words to do work

Astronauts on the upcoming 17-day Life and Microgravity Spacelab-1 mission may be wise to follow the old saw, "Be careful what you ask for, you might get it." That's because a team of JSC engineers is trying to make their words become their commands.

The in-flight test of the Voice Command System is a reflight of a development test objective first tried on STS-41. This time, however, the VCS is smarter and should be better able to handle variability in human speech.

The ultimate objective is to give astronauts "hands free" command of things like television cameras—something that would be very useful when someone is trying to drive the shuttle's robot arm *and* see what they are doing.

"For many of the applications such as camera control, glovebox experiments or the lower body pressure suit, voice recognition would provide an extra pair of hands for the astronauts," said Project Manager George Salazar of Engineering's Avionics Systems Division. "By speaking into a microphone, the astronauts could control several tasks at one time."



'I believe voice recognition as an operational tool in space is inevitable.'

—George Salazar
Voice Command System
Project Manager

Astronauts Bill Shepherd and Bruce Melnick used the original VCS design on STS-41. That system was speaker-dependent and the two crew members had to "train" it on the ground to recognize their voices. Their voice prints, or 1-G templates, for each spoken command were stored by the system. The problem: their voices changed once they arrived in the microgravity environment.

A backup "retain" capability allowed Shepherd and Melnick to create fresh templates that the system could recognize on orbit. After working with the retrain feature, both crew members were able to get the system to recognize their commands 98 percent of the time. The problem: the retrain templates were lost when the VCS was powered down.

"We learned a lot from this flight regarding the limitations of the system and the technology for space use," said Salazar, whose team has since worked on a redesign that is expected to overcome the STS-41 difficulties.

Unlike the original, the new design will learn the astronaut's voice the more it is used.

"Should the astronaut's voice change, the technology will learn the changed voice," Salazar explained. "More importantly, it will remember the changed voice. In effect, the recognizer will learn variations in the voice over time."

On STS-78, Commander Tom Henricks and Pilot Kevin Kregel will test the system's ability to operate selected functions of the orbiter Closed Circuit Television system by voice through the use of a shuttle headset. This "hands-free" approach to CCTV control could permit an astronaut to perform other tasks at the same time.

Salazar and his team—which included Dena Haynes and Darilyn Gaston of Avionics Systems and Marc Sommers, Hector DeLeon, Fred Clifton and Eric Kuehnel of Lockheed-Martin Avionics Systems Division's Electronics System Branch-used a new technique to program the STS-78 system to recognize the appropriate voices. The technique should make the system less sensitive to characteristics of a specific speaker and be less susceptible to problems arising from changing voices.

For STS-78, the words were pre-trained using a select group of speakers similar to the intended users of the system. Should the system not understand what was said, it learns through a series of questions to asking the astronaut what word was spoken. VCS automatically updates the voice models to take into account changes. The more an astronaut uses VCS, the better it recognizes the voice.

"We are using a speaker-independent board used in the telecommunication industry," Project Engineer Dena Haynes said. "We take advantage of the board's capability for adapting quickly to a user. In addition, we designed a unique analog board to handle the audio from the microphone in a more robust manner; that is, it senses if the microphone is receiving a low level signal or a high level signal and adjusts its amplification accordingly before submitting it to the recognizer board.

"Because of our STS-41 experience, we put a lot of emphasis in the feedback to the user via tones and audio as well as display messages," Salazar said. "There is a double-tone for transitioning from one node (subvocabulary made up of a group of words from the entire set of words) to another, a tone for indicating it recognized a word spoken, a buzzer to indicate it didn't understand you, and another unique double-tone indicating you spoke too soon or too soft."

The team also added macro commanding capability where just one word spoken can create camera scenes. An astronaut can say 'stow cameras' and all four payload cameras automatically are stowed in their ascent and reentry positions.

Work on the first VCS, which flew in October 1990, started around 1983. The redesign that will fly later this month started in 1991. And the future for the JSC team's VCS work is potentially bright.

"We would like to get on an RMS flight and simulate controlling the CCTV system using the VCS while performing RMS operations such as deploy or rendezvous of a payload," Salazar said. "There is where the power of voice recognition manifests itself."

"Another advantage of a properly designed voice control system is that the user does not have to entirely know how the system operates," Project Engineer Darilyn Gaston said. The user doesn't have to know what switch or series of switches to depress to get a camera to pan left or zoom in.

"For human beings, speech is the simplest, fastest means of communication. Variations in human speech still pose a challenge to recognition technology. However,with computer processing power increasing at an incredible rate, machines of today will eventually evolve into machines that will allow natural language interaction," Salazar said.

Although there currently is no requirement for voice recognition on the International Space Station, NASA's Canadian partners are looking at voice recognition for their module.

"I believe voice recognition as an operational tool in space is inevitable," Salazar said. "Who implements it first is the question."

In addition, there are numerous potential commercial applications such as in the area of helping physically challenged people. The team has applied for patents on several of this system's features. ❑